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NATIONAL DAM SAFETY PROGRAM. LIPPS LAKE DAM (MO 30214). MISSISS--ETC(U)
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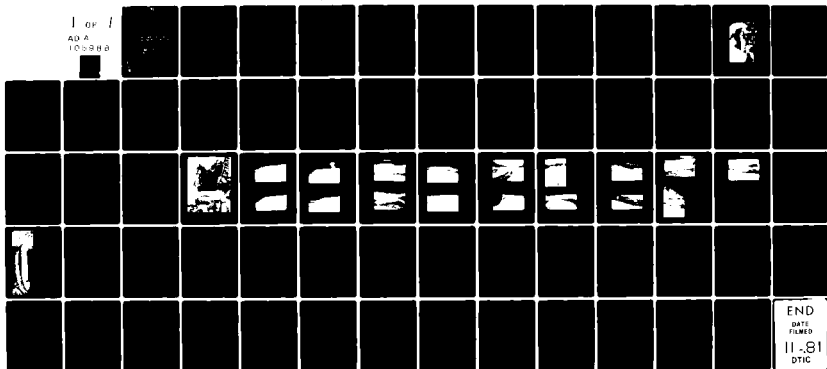
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MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

LIPPS LAKE DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 30214

AD A105988

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**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**



**United States Army
Corps of Engineers**

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St. Louis District

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PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

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OCTOBER, 1980

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LIPPS LAKE DAM
CAPE GIRARDEAU COUNTY, MISSOURI
MISSOURI INVENTORY NO. MO 30214

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR
GOVERNOR OF MISSOURI

OCTOBER, 1980

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

SUBJECT: Lipps Lake Dam - MO 30214

This report presents the results of field inspection and evaluation of the Lipps Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED 28 APR 1981
Chief, Engineering Division Date

APPROVED BY: SIGNED 28 APR 1981
Colonel, CE, District Engineer Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Lipps Lake Dam
State Located	Missouri
County Located	Cape Girardeau County
Stream	Tributary to Little Indian Creek
Date of Inspection	October 30, 1980

Lipps Lake Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderregger, Inc. The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Lipps Lake Dam has a height of seventy-five (75) feet and a storage capacity at the minimum top elevation of the dam of six hundred forty (640) acre-feet. In accordance with the guidelines, an intermediate size dam has a height greater than or equal to forty (40) feet but less than one hundred (100) feet and a storage capacity greater than or equal to one thousand (1,000) acre-feet but less than fifty thousand (50,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Lipps Lake Dam is classified as an intermediate size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately three (3) miles downstream of the dam to the Mississippi River flood plain. Within the damage zone are four dwellings, a barn, Highway V, two trailer houses and Highway 117.

Our inspection and evaluation indicate that Lipps Lake Dam meets the criteria set forth in the recommended guidelines for an intermediate size dam having a high hazard potential. There are no spillways for this dam. The Probable Maximum Flood, which is the appropriate spillway design flood, will be contained by this dam with no outflow and with no danger of overtopping. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

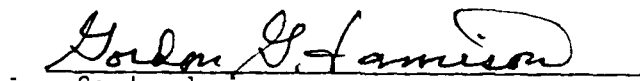
Lipps Lake Dam is in good condition. The deficiencies noted are the lack of good vegetative cover on the embankment slopes, tree and brush growth on the embankment slopes and the lack of seepage and stability analyses as required by the guidelines for all dams having a high hazard potential.

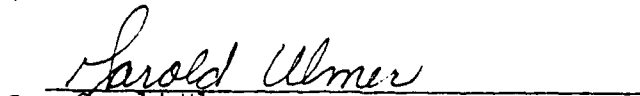
No design data were available for this dam. Based on the observations and measurements made during the inspection and upon the hydraulic/hydrologic analysis performed for this dam, no modification of the dam is considered necessary.

The following recommendations are made in regard to operation and maintenance of the dam:

- (1) Seepage and stability analysis comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.
- (2) A good vegetative cover of adapted grasses and legumes should be established on the embankment slopes, particularly the upstream slope.
- (3) To facilitate maintenance of the recommended vegetative cover tree growth should be removed from the upstream slope and measures should be taken to prevent their recurrence.
- (4) Tree growth on the downstream slope should be removed below about elevation 420 and measures should be taken to prevent recurrence. This should protect the area below maximum potential phreatic surface emergence.
- (5) Tree and brush growth on the downstream slope above elevation 420 should be selectively removed and controlled so that grass and legume cover can be maintained and future inspections can be easily conducted.
- (6) A program of periodic inspection and maintenance should be initiated with inspection reports being made a part of the file on this dam. This program should be carried out under the guidance of an engineer experienced in the design and construction of dams.


Rey S. Decker
E-3703


Gordon Jamison


Garold Ulmer
E-19246

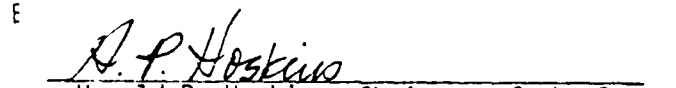

Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sonderegger, Inc.
E-8696



PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LIPPS LAKE DAM - MO 30214
CAPE GIRARDEAU COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Lipps Lake Dam be made.
- b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances.
 - (1) Embankment. The embankment is a compacted earthfill approximately 800 feet in length and 75 feet in height. The maximum storage capacity at the minimum top elevation of the dam is 640 $\pm$ acre-feet.
 - (2) Principal Spillway. There is no principal spillway.
 - (3) Emergency Spillway. There is no emergency spillway.
 - (4) Low-Level Outlet. There is no low-level outlet.
 - (5) Pertinent physical data are given in paragraph 1.3.
- b. Location. The dam is located in the northcentral portion of Cape Girardeau County, Missouri, approximately 9 miles north of the

city of Cape Girardeau, as shown on Plate A-2. The dam and reservoir are shown on Plate A-1 in the SE 1/4 Sec. 7, T32N, R14E.

- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Lipps Lake Dam has a height of 75 feet $\pm$ and a storage capacity of 640 acre-feet. This dam is classified as an intermediate size dam. An intermediate size dam has a height greater than or equal to 40 feet but less than 100 feet and a storage capacity greater than or equal to 1,000 acre-feet but less than 50,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.
- d. Hazard Classification. Guidelines for determining hazard classification of dams and impoundments are presented in the guidelines as referenced in paragraph 1.1c above.

Aerial photographs of the downstream damage zone of this dam were taken in October, 1980. These photographs were used as reference in the field observations of the damage zone which were made during the inspection. Based on the field observations and on the referenced guidelines, this dam is in the High Hazard Potential Classification. The estimated damage zone extends approximately three miles downstream of the dam to the Mississippi River flood plain. Within the damage zone are four dwellings, a barn, Highway V, two trailer houses and Highway 117. Photos 1, 8, 9 and 18 show the damage zone.

- e. Ownership. This dam is owned by Mr. Jerry Lipps, 130 S. Frederick, Cape Girardeau, Missouri 63701.
- f. Purpose of Dam. The dam was built for recreational purposes.
- g. Design and Construction History. No design or construction data were available for this dam. Mr. Lipps reported that he built this dam himself in 1973.
- h. Normal Operating Procedure. There are no operating facilities for this dam. The pool level is controlled by rainfall, infiltration, and evaporation.

1.3 PERTINENT DATA

- a. Drainage Area. 63.1 acres (0.099 square miles).
- b. Discharge at Damsite.
 - (1) There are no outlet facilities for this dam.
 - (2) Estimated maximum flood at damsite -- Unknown. (Based on high water marks the reservoir has risen to an elevation of 439.8).

c. Elevations (feet above M.S.L.).

- (1) Observed pool - 436.2
- (2) Normal pool - unknown
- (3) Spillway crests - there are no spillways
- (4) Maximum experienced pool - 439.8 (observed high water line)
- (5) Top of dam (minimum) - 466.8
- (6) Steambed - 399[±]
- (7) Maximum tailwater - none

d. Reservoir. Length (feet) of pool.

- (1) At observed pool - 1100[±]
- (2) At top of dam (minimum) - 2500[±]

e. Storage (acre-feet).

- (1) Observed pool - 142[±]
- (2) Normal pool - unknown
- (3) Spillway crests - there are no spillways
- (4) Maximum experienced pool - 180[±]
- (5) Top of dam (minimum) - 640[±]

f. Reservoir Surface (acres).

- (1) Observed pool - 9.5[±]
- (2) Normal pool - unknown
- (3) Spillway crests - there are no spillways
- (4) Maximum experienced pool - 11[±]
- (5) Top of dam (minimum) - 25.5[±]

g. Dam.

- (1) Type - earthfill
- (2) Length - 800 feet

- (3) Height - 75 feet (maximum)
- (4) Top width - variable (16 ft. to 33 ft.)
- (5) Side slopes
 - (a) Downstream - 1V on 1.6H - crest to berm
1V on 20.2H - berm
1V on 2.1/2.9/3.3/4.1/5.4H - berm to toe
 - (b) Upstream - 1V on 2.5H
- (6) Zoning - reported as homogeneous fill
- (7) Impervious core - homogeneous fill
- (8) Cutoff - unknown (reported to rock)
- (9) Grout curtain - none
- (10) Wave protection - none
- (11) Drains - none
- h. Diversion Channel and Regulating Tunnel. None
- i. Spillways. There are no spillways for this dam.
- j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. Mr. Lipps reported he built this dam in 1973 using DW-21 scrapers and dozers.

2.3 OPERATION

There are no operating facilities for this dam.

2.4 EVALUATION

- a. Availability. No data were available.
- b. Adequacy. The field surveys and visual observations presented in this report are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. A visual inspection of the Lipps Lake Dam was made on October 30, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were:

Rey S. Decker - Geotechnical
Garold G. Ulmer - Hydraulics and Hydrology
Gordon Jamison - Hydraulics and Hydrology
Roy Elliott - Geology

The owner, Mr. Jerry Lipps, was interviewed prior to the inspection but was not present during the inspection.

- b. Dam.

- (1) Geology and Soils (abutment and embankment). The embankment is situated in a bedrock controlled upland drainage. The physiographic province is typical of the eastern margin of the Ozark uplift, gently dipping Paleozoic bedrock incised by modern drainage and mantled by moderate to thick loess. The thinly to massive bedded limestones are interbedded with chert and shale. The bedrock formations are exposed in the upstream right abutment. They are Devonian in age and locally fossiliferous (ammonites, brachiopods and crinoids). The underlying bedrock dips gently to the east at less than 5°. Structural features of local importance are the Jackson Fault 7 miles to the south; Brooks Dome 6 miles to the south-southeast and Bodenschatz-Lick Fault of the Genevieve Fault System 9 miles to the north-northwest. The embankment is located in Seismic Zone 3 which is indicative of major seismic probability. Earthquakes with Modified Mercalli intensities greater than or equal to V occurred in 1819 and twice in 1977 within 25 radial miles of the site. Within this radius earthquakes with minor intensities (I to IV) were recorded in 1928, 1938, 1940, 1944 and 1977.

Loess deposits ranging in thickness from 1 to 15 feet mantle the hilltops and valley slopes. The soils in the drainage basin consist of the Menfro-Winfield association which are developed on loess overlying cherty limestone. Materials in the embankment and abutments consist of CL-ML loess and CL-CH residuum with considerable cherty gravel which has been borrowed from the abutment areas. Materials were field classified from samples taken by hand auger.

Groundwater movement at and adjacent to the embankment is controlled by bedding and fractures in the limestone and the

poorly sorted clayey gravel alluvium. Solution cavitation was not observed in the limestones. "Perched" drainage of the loess mantle was observed on the massive cherty limestone at the crest of the right abutment. This seep should not affect the stability of the structure due to its location and small recharge area.

- (2) Upstream Slope. The upstream slope has a very sparse vegetative cover of weeds and annuals. There are a number of small Sycamore trees growing on the upstream slope. There is no riprap on the upstream face, and there is a definite wash line about 3.5[±] feet above the present water surface. There were no indications of slumps, cracks, slides or rodent activity on the slope. Some erosional rills, up to 8 to 12 inches in depth, were observed on the slope. Photos 2, 11, & 13 show the upstream slope.
- (3) Crest. Station 3+00 on the left side is approximately 9 feet higher than Station 10+00 on the right end. The profile slopes uniformly between these stations. The width of the crest varies from 16 feet minimum to 33 feet maximum. The crest is sparsely vegetated with weeds and annuals and serves as a road for vehicular travel. The material on the crest is CL-CH with cherty gravel. No cracks, deformations, evidence of unequal settlement, or rodent holes were observed. There is a seep area on the right abutment (Station 10+00) at or slightly above the top of dam elevation. It apparently emerges from the abutment and has no connection with the reservoir or stability of the dam. Photos 14 and 17 show the spring on top of the dam. Photos 3 and 10 show the crest.
- (4) Downstream Slope. The downstream slope has a sparse vegetative cover of grass and weeds. There is a wide berm on the downstream slope located approximately 23 feet below the crest elevation at the maximum section. The berm width varies considerably, ranging from approximately 20 to 60 feet. There was no evidence of cracks, slides, slumps, excessive erosion or rodent holes on the downstream slope. Seepage was not observed along the toe of the slope. A few small Sycamore trees are growing on the slope and berm. A few small Willow trees are growing on the slope downstream from about Station 5+50 to 7+50. These Willows are located at about elevation 415 which should be about the emerging elevation of the phreatic line with the pool elevation at 436 to 440. No other signs of seepage were observed on the slope. Photos 4, 5, 15, and 16 show the downstream slope.
- (5) Miscellaneous. This dam appears to be at least a third higher than would normally be constructed for a small watershed of this size. The abnormally large cross-section of the dam resulting from the overbuilding should preclude any impairment

to the safety of the embankment from tree growth on the slopes or from natural emergence of the phreatic line on the downstream slope.

- c. Appurtenant Structures. There are no spillways or draw-down facilities for this dam.
- d. Reservoir Area. There is no significant erosion around the shoreline. All trees have been removed around the periphery some 20 to 30 feet above the waterline and there is evidence that some of the shoreline material was used as borrow for the dam. There was no evidence of siltation in the reservoir. The remainder of the cleared area probably reflects the owner's optimistic plans for a much larger reservoir than the watershed can support. Photos 6 and 7 show these conditions.
- e. Downstream Channel. There is no evidence of channel use over the past few years. It appears the original channel has been filled in with tailings and undesirable construction material. Photos 8 and 9 show the area downstream from the dam.

3.2 EVALUATION

This dam appears to be safe from the standpoint of shear failures and/or seepage pressures. The fact that the upper one-third of the downstream slope is steeper than normal should not detract from the safety of the dam since it is doubtful that the reservoir level will ever approach this elevation. The relatively low reservoir level, the nature of the materials in the dam, and the abnormally large base width and cross-section of the dam should preclude any serious impairment to the safety of the dam by tree growth, by emergence of the phreatic line, and by seismic activity.

There are no spillways or draw-down facilities for this dam. It is remotely possible that concurrent storms of high intensity and/or duration could fill the reservoir to within a few feet of top of the dam. Under such circumstances it would probably be advisable to then construct a spillway or other measures to lower and/or control the level of the reservoir.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no outlet works for this dam. The pool level is controlled by rainfall, infiltration, and evaporation.

4.2 MAINTENANCE OF DAM

There does not appear to be any regular maintenance program for this dam. Some small gully and rill erosion is evident on the upstream slope. A few small Sycamore and Willow trees are growing on both slopes of the dam.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

Although it appears that the abnormally large cross-section of this dam would preclude any serious damage to the structure from tree growth, it would be advisable to remove the small trees from the embankment and measures should be taken to prevent their recurrence. Removal of the trees at this stage will facilitate future maintenance of the structure. It would also be advisable to establish a good vegetative cover of adapted grasses and legumes (crown vetch) on the slopes of the embankment. The lack of outlet works for this structure could result in problems of reservoir stagnation and eutrophication unless some special measures are initiated.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. There were no design data available for this dam.
- b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Cape Girardeau NE, MO. 7-1/2 minute topographic quadrangle map.
- c. Visual Observations.
 - (1) The size of this dam, in comparison to its contributing drainage area, is so large that the lack of outflow facilities is of little consequence.
- d. Overtopping Potential. There is no overtopping potential. Without outflow facilities the probable maximum flood pool elevation is approximately 15 feet below the minimum top of dam.

The results of the routings through the dam are tabulated in regards to the following conditions:

<u>Frequency</u>	<u>Inflow Discharge c.f.s.</u>	<u>Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>*Maximum Depth Over Dam Feet</u>	<u>Duration Over Top Hours</u>
1%	195	0	441.2	-	-
1/2 PMF	615	0	446.7	-	-
PMF	1230	0	452.3	-	-

* Minimum top of dam elevation - 466.8 feet.

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard potential and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam.

The estimated damage zone is described in paragraph 1.2 d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. This dam appears to be structurally stable against shear failures and seepage pressures. No evidence of stress such as cracks, slumps, slides or deformations were observed during the inspection. There, also, was no evidence of seepage through the embankment or along the toe.

Appendix E of this report contains a preliminary static slope stability analysis which was performed for this dam.

- b. Design and Construction Data. No design or construction data were available for this dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. Computer assisted static slope stability analyses were performed for this report. Results of these analyses are included in Appendix E.
- c. Operating Records. There are no operating facilities for this dam.
- d. Post-Construction Changes. The inspection team is not aware of any post-construction changes.
- e. Seismic Stability. This dam is located in Seismic Zone 3 as shown on Plate A-3. An earthquake of the magnitude predicted in this area could be expected to cause some damage to this dam. However, preliminary static stability analyses using horizontal acceleration of 0.15g produced safety factors that are generally acceptable. (See Appendix E).

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

- a. Safety. This dam appears to be structurally stable with only a slight possibility of failure from shear, seepage and/or seismic stresses. Approximate analyses, presented in this report, indicate that the dam will impound the probable maximum flood with about 15 feet of free board.

There are no spillways or draw-down facilities for this dam. It is remotely possible that concurrent storms of high intensity and/or duration could fill the reservoir to within a few feet of top of the dam. Under such circumstances it would probably be advisable to then construct a spillway or other measures to lower and/or control the level of the reservoir. The lack of outlet works for this structure could result in problems of reservoir stagnation and eutrophication unless some special measures are initiated.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. However, preliminary slope stability analyses, presented in Appendix E of this report, indicate that this dam would be structurally stable under full pool (PMF) and steady seepage with earthquake forces expected for this area. Considering the abnormally large cross-section of this dam, it is doubtful that surface erosion on the upstream slope and tree growth on the embankment would ever result in serious potential of failure. However, the establishment of good grass and/or legume cover on the slopes and control of the tree growth will minimize and ease future maintenance requirements for this structure.

- b. Adequacy of Information. No engineering data were available for this dam. The information collected during the inspection, the analyses presented in Section 5 and the performance history of the dam are considered adequate to support the conclusions presented in this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Urgency. There does not appear to be any urgency to perform the remedial measures recommended in paragraph 7.2.
- d. Necessity for Further Investigation. There is no apparent need for Phase II investigations.
- e. Seismic Stability. This dam is located in Seismic Zone 3 as shown on Plate A-3. An earthquake of this magnitude could be expected to cause some damage to this dam. It is recommended that the

prescribed seismic loading for Seismic Zone 3 be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a registered professional engineer experienced in the design and construction of earth dams.

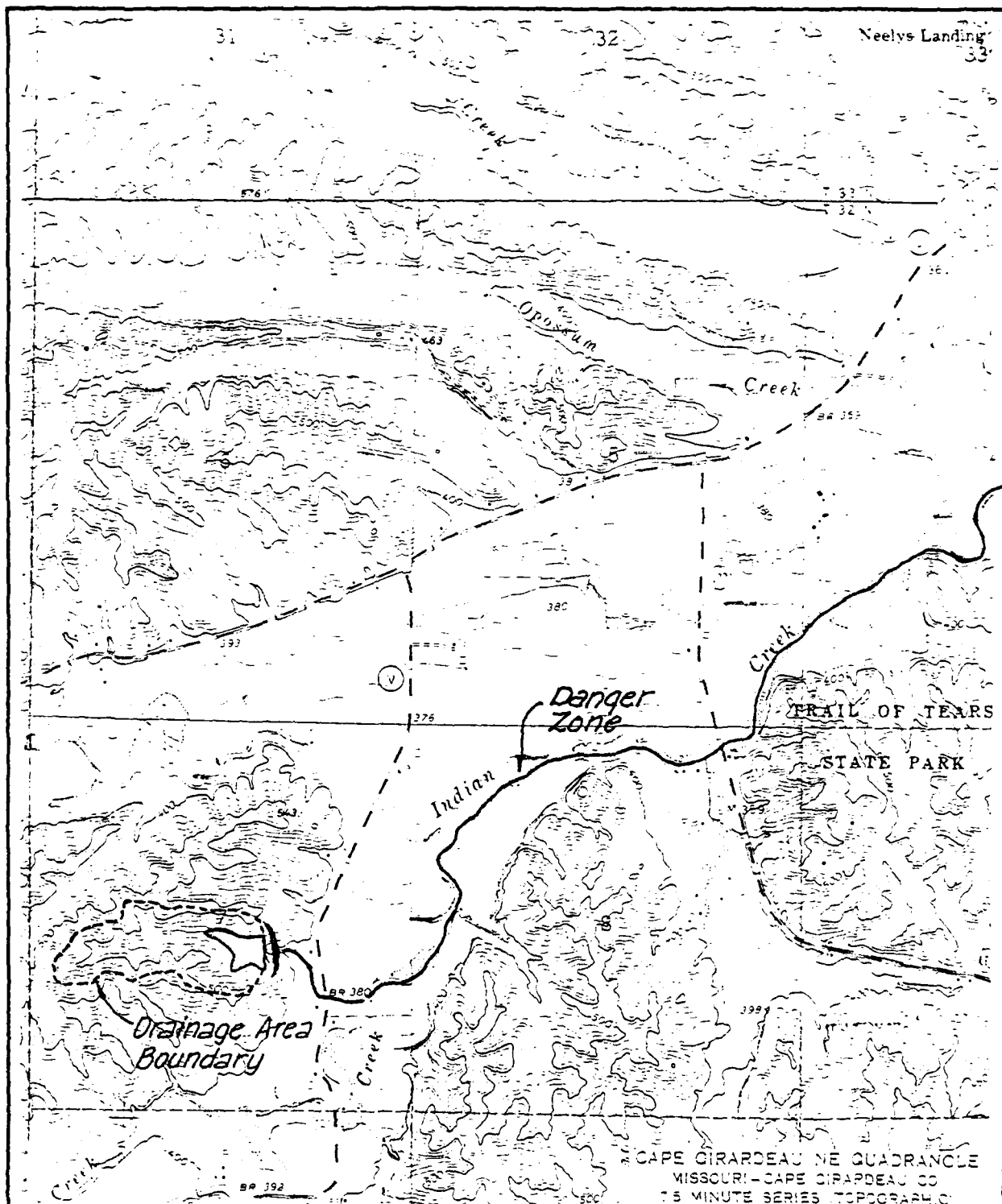
a. Alternatives.

- (1) Since the dam will impound the Probable Maximum Flood with no danger of overtopping, no alternatives are required.

b. Operation and Maintenance Procedures.

- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the design and construction of dams.
- (2) A good vegetative cover of adapted grasses and legumes should be established on the embankment slopes, particularly the upstream slope.
- (3) To facilitate maintenance of the recommended vegetative cover, tree growth should be removed from the upstream slope and measures should be taken to prevent their recurrence.
- (4) Tree growth on the downstream slope should be removed below about elevation 420 and measures should be taken to prevent recurrence. This should protect the area below maximum potential phreatic surface emergence.
- (5) Tree and brush growth on the downstream slope above elevation 420 should be selectively removed and controlled so that grass and legume cover can be maintained and future inspections can be easily conducted.
- (6) A program of periodic inspection and maintenance should be initiated with inspection reports being made a part of the file on this dam. This program should be carried out under the guidance of an engineer experienced in the design and construction of dams.

APPENDIX A
MAPS



Scale in feet
2000 1000 0 2000 4000

Contour Interval - 20'



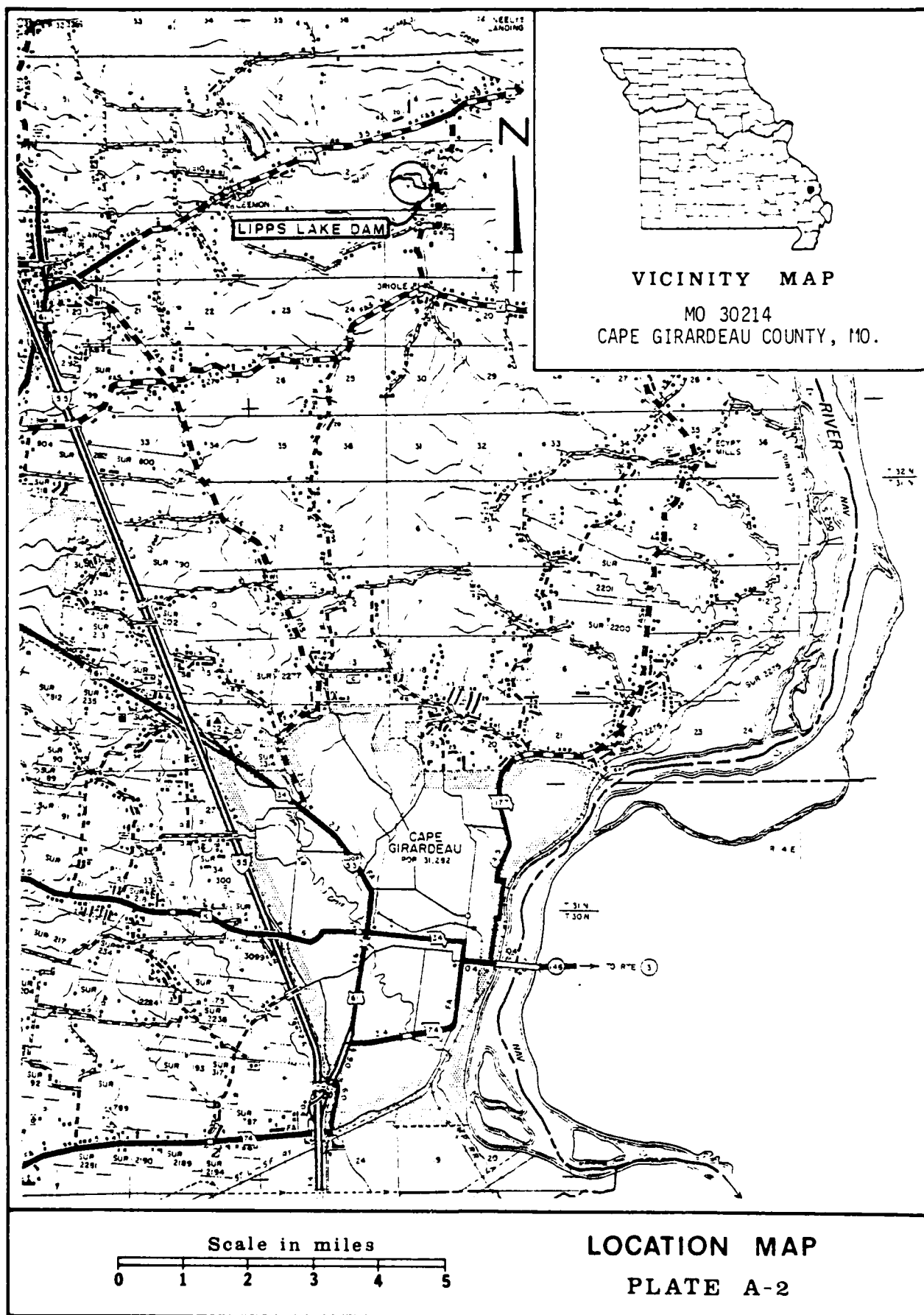
VICINITY TOPOGRAPHY

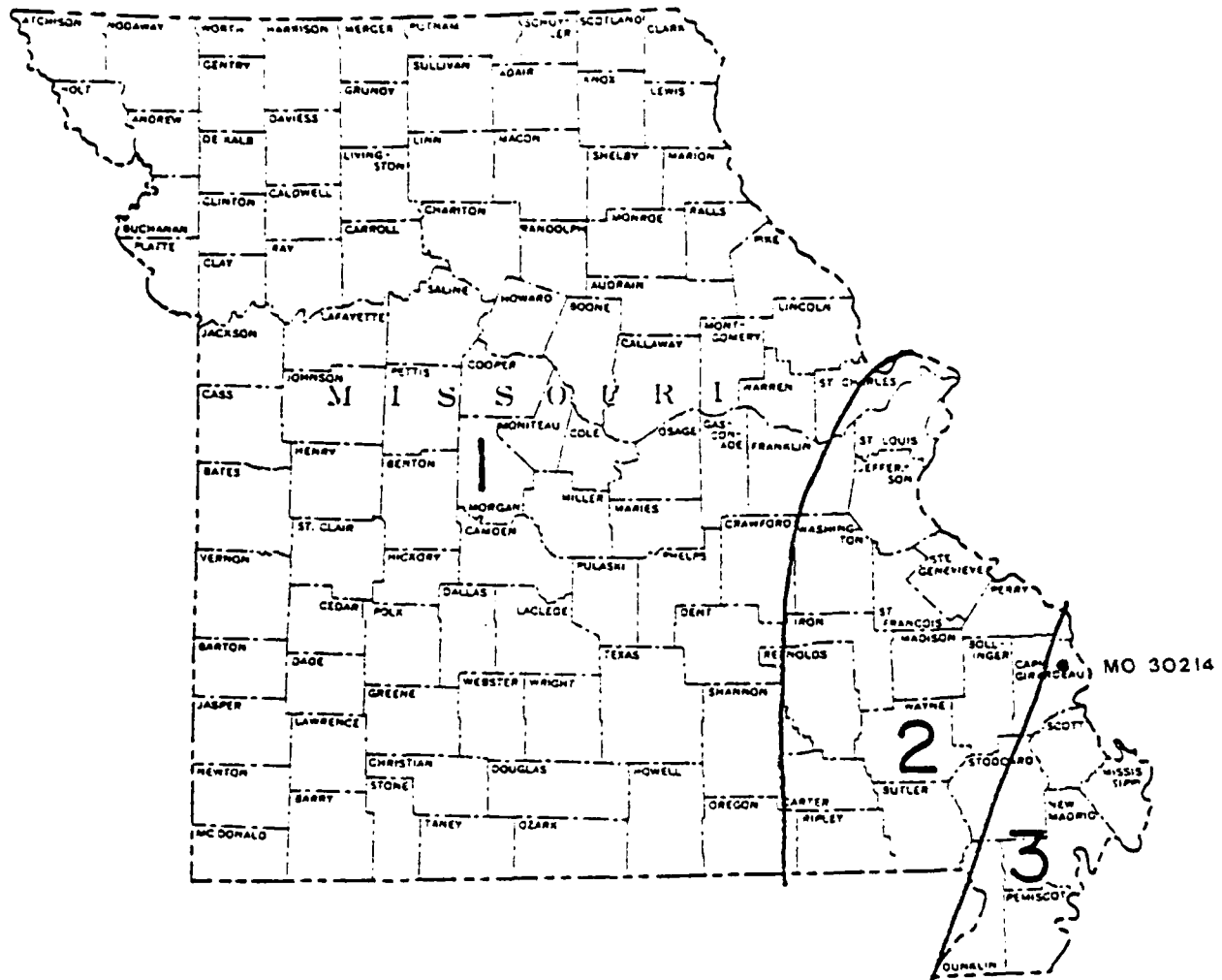
LIPPS LAKE DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 30214

PLATE A-1





MISSOURI
SEISMIC ZONE MAP

APPENDIX B
PHOTOGRAPHS



LIPPS LAKE DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 30214

PHOTO INDEX

PLATE B-1



PHOTO NO. 2 - UPSTREAM SLOPE TAKEN FROM LEFT END



PHOTO NO. 3 - CREST AS SEEN FROM LEFT END



PHOTO NO. 4 - DOWNSTREAM SLOPE AND TOP OF BERM AS SEEN FROM LEFT END



PHOTO NO. 5 - DOWNSTREAM SLOPE AND TOP OF BERM AS SEEN FROM LEFT END

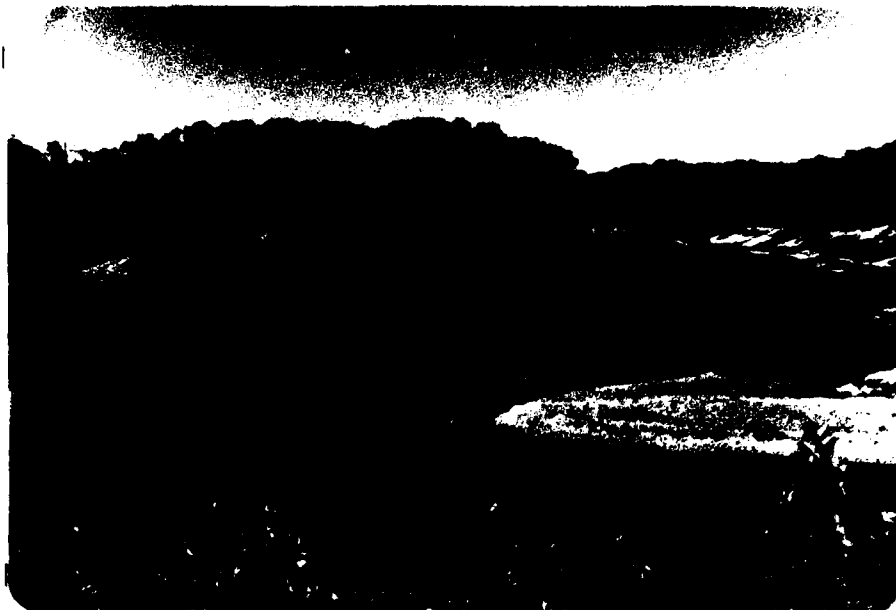


PHOTO NO. 6 - LOOKING UPSTREAM FROM STATION 5 + 00



PHOTO NO. 7 - LOOKING UPSTREAM FROM STATION 5 + 00



PHOTO NO. 8 - LOOKING DOWNSTREAM FROM STATION 5 + 00 SHOWING
DAMAGE AREA JUST BELOW DAM



PHOTO NO. 9 - LOOKING DOWNSTREAM FROM STATION 5 + 00 SHOWING
DAMAGE AREA JUST BELOW DAM



PHOTO NO. 10 - CREST OF DAM FROM RIGHT END



PHOTO NO. 11 - UPSTREAM SLOPE AS SEEN FROM RIGHT ABUTMENT



PHOTO NO. 12 - VIEW SHOWING
EXPOSURE IN RIGHT ABUTMENT



PHOTO NO. 13 - OVERVIEW FROM HIGH UPSTREAM ON THE CENTER POINT



PHOTO NO. 14 - SPRING AREA ON TOP OF THE DAM, PAST STATION
10 + 00



PHOTO NO. 15 - DOWNSTREAM SLOPE FROM RIGHT ABUTMENT TROUGH



PHOTO NO. 16 - VIEW SHOWING FOXTAIL IN THE LEFT ABUTMENT
TROUGH AND WILLOWS ON DOWNSTREAM SLOPE LOOKING UP SLOPE



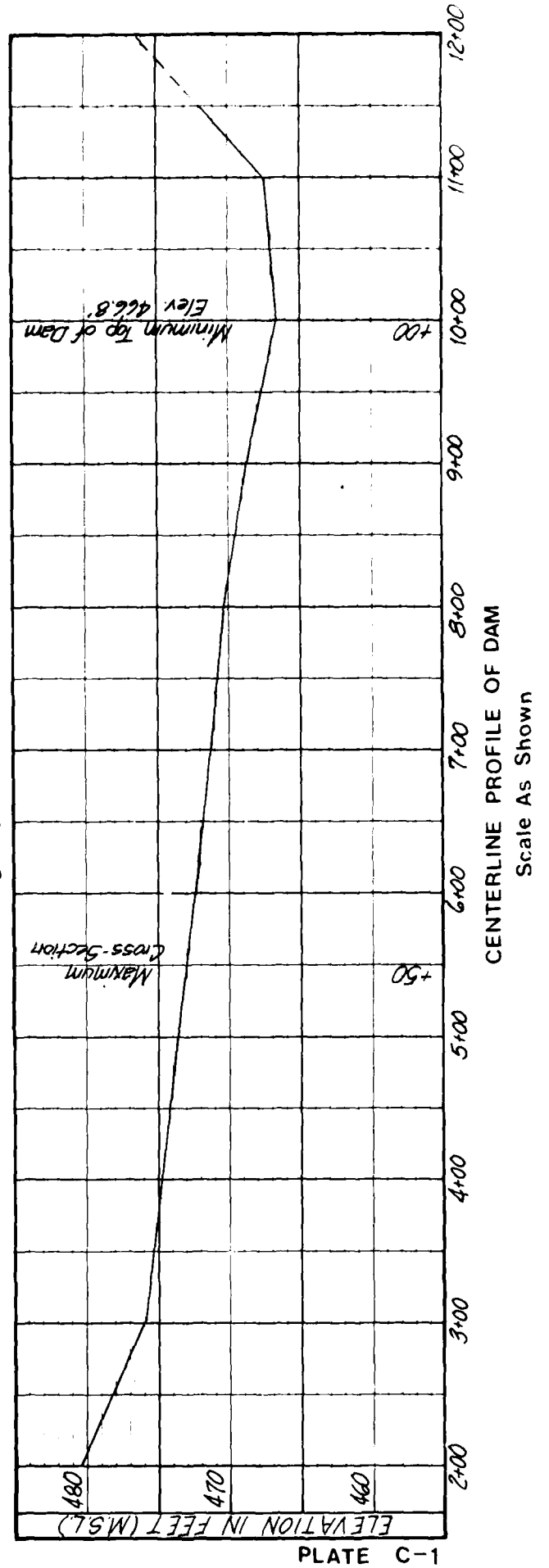
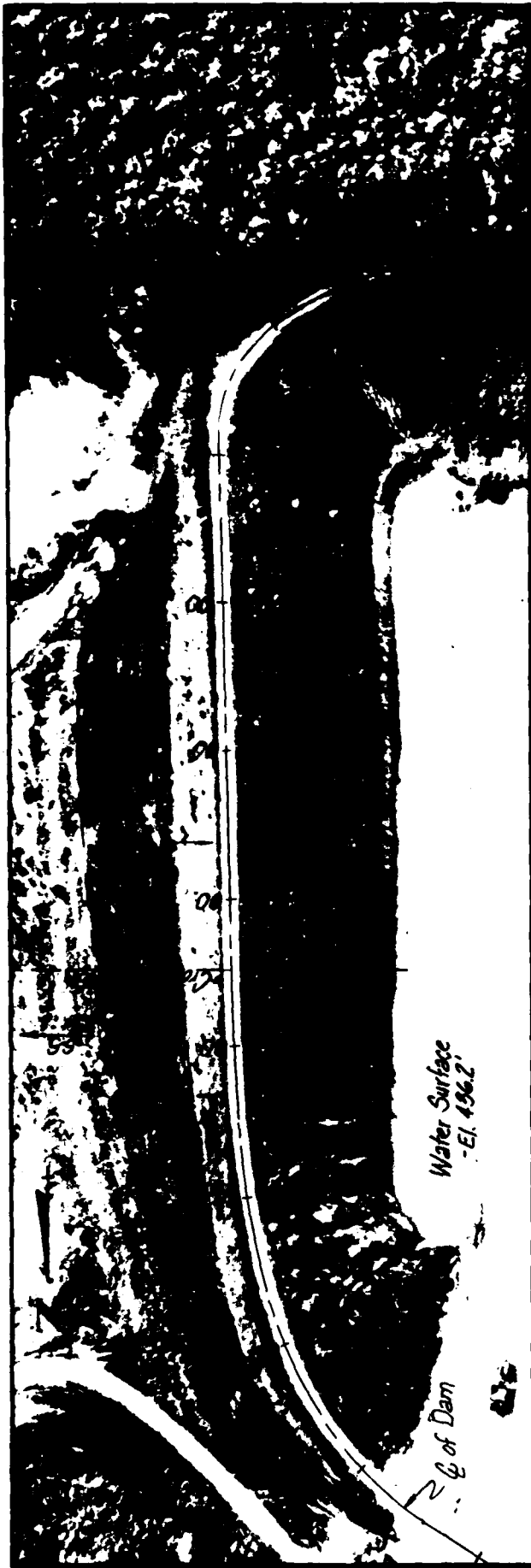
PHOTO NO. 17 - SPRING AREA
ON TOP OF DAM LOOKING BACK
(WEST) INTO THE HILL

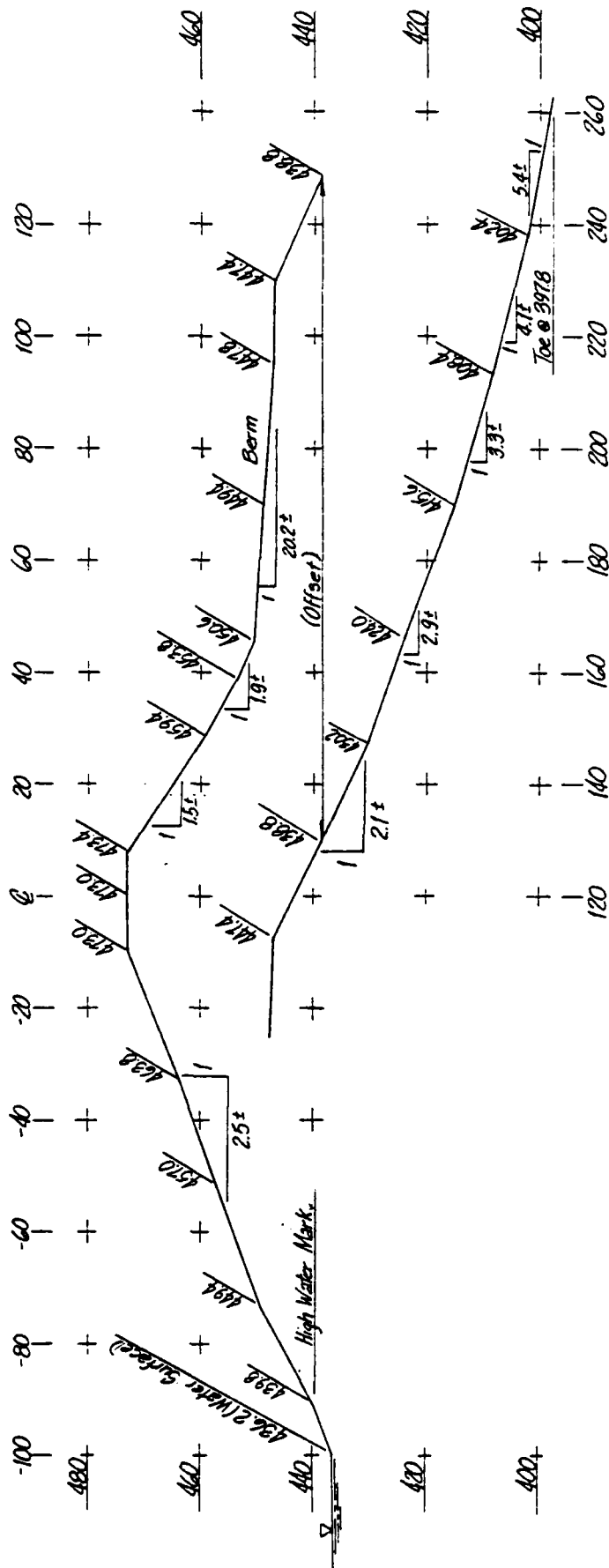
FORM 12 8-1-12



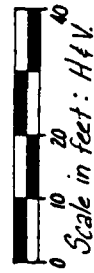
PHOTO NO. 18 - VIEW SHOWING TRAILER HOMES IN HAZARD AREA
WEST OF ROAD

APPENDIX C
PROJECT PLATES





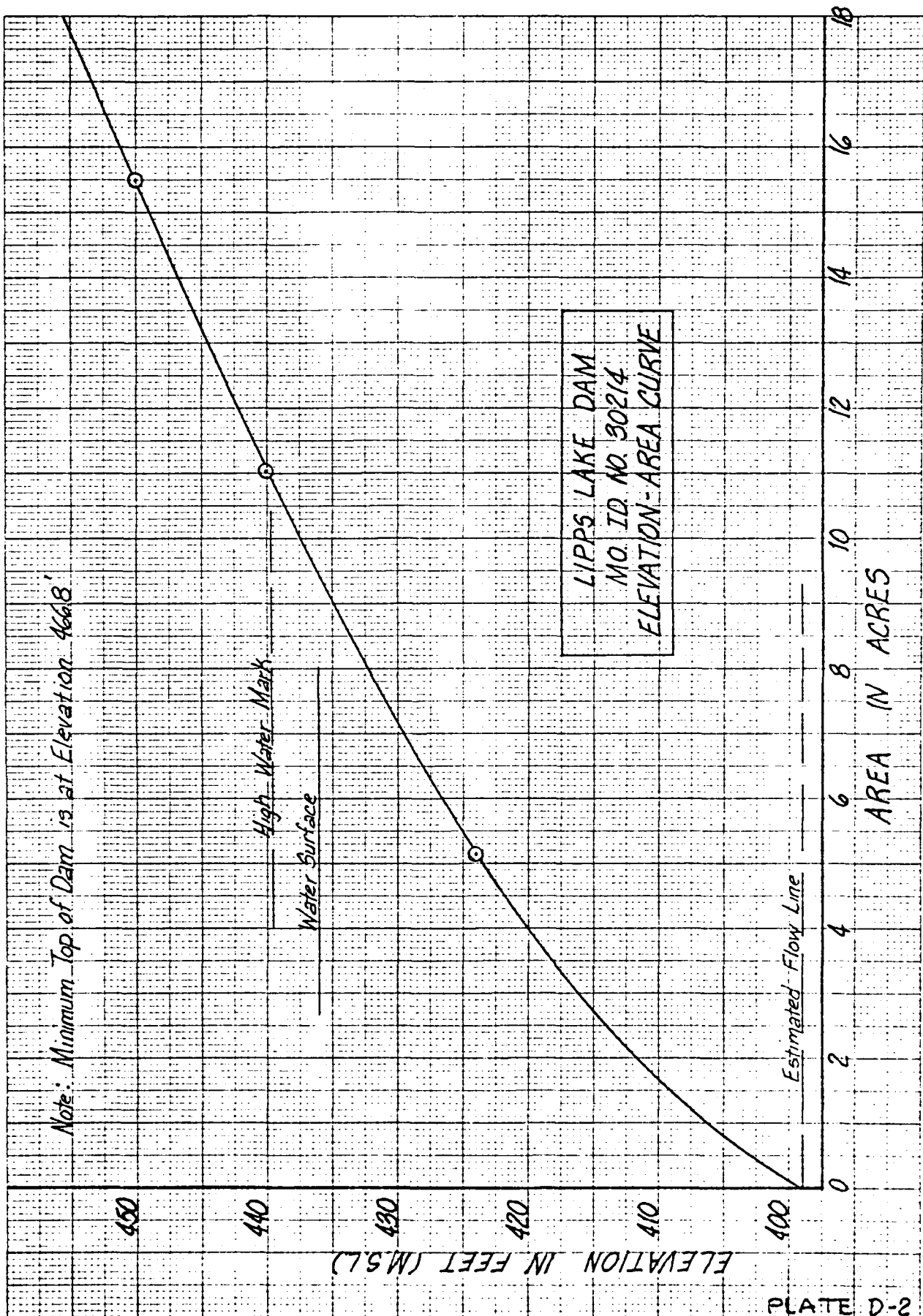
MAXIMUM CROSS-SECTION OF DAM AT STATION 5+50



APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (see this Appendix).
 - a. Twenty-four hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Cape Girardeau, MO. as supplied by the St. Louis District, Corps of Engineers per their letter dated 4 March 1980. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.
 - b. Drainage area = 0.099 square miles (63.1 acres).
 - c. Time of concentration of runoff = 12 minutes (computed from the Kirpich formula and formula from California Culverts Practice, California Highways and Public Works).
 - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one percent probabilistic precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the maximum wash line elevation as determined in the field surveys.
 - e. The total twenty-four hour storm duration losses for the one percent probabilistic storm were 4.02 inches. The total losses for the PMF storm were 2.67 inches. These data are based on SCS runoff curve No. 64 and No. 81 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed primarily of SCS soil group B (Menfro-Clarksville complex). Land use is 90% woods and 10% impervious.
 - f. Average soil loss rates = 0.10 inch per hour approximately (for PMF storm, AMC III).
2. The only outflow possibility for this dam would be that over the top of the dam.
3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the dam embankment crest. The input and plotted hydrographs are attached in this Appendix.



 FLOOD CONTROL DISTRICT
 DAM SAFETY DIVISION
 LAST MODIFICATION 26 FEB 1978

RUN DATE 00/12/11.
 TIME 17.47.93.

LIPPS LAKE DAM/MO ID NO 50214
 SAFETY-ANALYSIS OF DAM OVERTOPPING USING ASSIGNED FLOOD FREQUENCIES
 H & H ANALYSIS BY ROUTING PMF RATIOS THRU THE RESERVOIR

NO 288 NHN 0 NMIN 5 JOYER 5 IDAY 0 JHR 0 IRIN 0 METRC 0 IPLT 0 IPHT 3 INSTAN 0
 JOB SPECIFICATION
 LKOP 0 TRACE 0

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NHTIO= 7 LKTIU= 1
 HTIO= .10 .20 .40 .50 .60 .80 1.00

***** SUB-AREA RUNOFF COMPUTATION *****

CALCULATION OF INFLOW-HYDRO TO LIPPS LAKE

ISTAO 000001 ICOMP 0 IECUN 0 ITAPE 0 JPLT 0 INAME I STAGE 0 IAUTO 0

INHYG 1 LUNG 2 TAREA 10 SNAP INSDC HYDROGRAPH DATA
 RATIO 0.000 ISNOW 0 ISAME 1 LOCAL 0

PRECIP DATA
 SPFE 0.00 PMS 27.00 H6 102.00 H12 121.00 R24 150.00 R46 0.00 R96 0.00

LKOPJ 0 STIRK 0 DLYKH 0.00 NIOL 1.00 ERAIN 0.00 LOSS DATA RTIOK STRTL CNSTL ALSMX RTIMP
 0.00 0.00 0.00 0.00 1.00 -1.00 -81.00 0.00 0.00

CURVE NO = -81.00 WEIKNSS = -1.00 EFFECT CN = 81.00

UNIT HYDROGRAPH DATA
 TC= 0.00 LAG= .17

RECESSION DATA
 STRTD= 0.00 GRCSH= -.01 RTIOK= 1.00

UNIT HYDROGRAPH 12 LND OF PERIOD ORIGINATES, TC= 36, 0.00 HOURS, LAG= 10, .17 VOL= 1.00 3.
 69. 208. 214. 67. 19. 5.

MO. UA	HR. MH	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW	HR. MH	PERIOD	MAIN	EXCS	LOSS	COMP U
1.01	0.05	1	0.01	0.00	0.01	1.01	12.05	145	23	21	02	60.
1.01	1.05	2	0.01	0.00	0.01	1.01	12.10	146	23	21	02	60.
1.01	2.05	3	0.01	0.00	0.01	1.01	12.15	147	23	21	02	60.
1.01	3.05	4	0.01	0.00	0.01	1.01	12.20	148	23	21	02	60.
1.01	4.05	5	0.01	0.00	0.01	1.01	12.25	149	23	21	02	60.
1.01	5.05	6	0.01	0.00	0.01	1.01	12.30	150	23	21	02	60.
1.01	6.05	7	0.01	0.00	0.01	1.01	12.35	151	23	21	02	60.
1.01	7.05	8	0.01	0.00	0.01	1.01	12.40	152	23	21	02	60.
1.01	8.05	9	0.01	0.00	0.01	1.01	12.45	153	23	21	02	60.
1.01	9.05	10	0.01	0.00	0.01	1.01	12.50	154	23	21	02	60.
1.01	10.05	11	0.01	0.00	0.01	1.01	12.55	155	23	21	02	60.
1.01	11.05	12	0.01	0.00	0.01	1.01	13.00	156	23	21	02	60.
1.01	12.05	13	0.01	0.00	0.01	1.01	13.05	157	23	21	02	60.
1.01	13.05	14	0.01	0.00	0.01	1.01	13.10	158	23	21	02	60.
1.01	14.05	15	0.01	0.00	0.01	1.01	13.15	159	23	21	02	60.
1.01	15.05	16	0.01	0.00	0.01	1.01	13.20	160	23	21	02	60.
1.01	16.05	17	0.01	0.00	0.01	1.01	13.25	161	23	21	02	60.
1.01	17.05	18	0.01	0.00	0.01	1.01	13.30	162	23	21	02	60.
1.01	18.05	19	0.01	0.00	0.01	1.01	13.35	163	23	21	02	60.
1.01	19.05	20	0.01	0.00	0.01	1.01	13.40	164	23	21	02	60.
1.01	20.05	21	0.01	0.00	0.01	1.01	13.45	165	23	21	02	60.
1.01	21.05	22	0.01	0.00	0.01	1.01	13.50	166	23	21	02	60.
1.01	22.05	23	0.01	0.00	0.01	1.01	13.55	167	23	21	02	60.
1.01	23.05	24	0.01	0.00	0.01	1.01	14.00	168	23	21	02	60.
1.01	24.05	25	0.01	0.00	0.01	1.01	14.05	169	23	21	02	60.
1.01	25.05	26	0.01	0.00	0.01	1.01	14.10	170	23	21	02	60.
1.01	26.05	27	0.01	0.00	0.01	1.01	14.15	171	23	21	02	60.
1.01	27.05	28	0.01	0.00	0.01	1.01	14.20	172	23	21	02	60.
1.01	28.05	29	0.01	0.00	0.01	1.01	14.25	173	23	21	02	60.
1.01	29.05	30	0.01	0.00	0.01	1.01	14.30	174	23	21	02	60.
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1.01	31.05	32	0.01	0.00	0.01	1.01	14.40	176	23	21	02	60.
1.01	32.05	33	0.01	0.00	0.01	1.01	14.45	177	23	21	02	60.
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1.01	37.05	38	0.01	0.00	0.01	1.01	15.10	182	23	21	02	60.
1.01	38.05	39	0.01	0.00	0.01	1.01	15.15	183	23	21	02	60.
1.01	39.05	40	0.01	0.00	0.01	1.01	15.20	184	23	21	02	60.
1.01	40.05	41	0.01	0.00	0.01	1.01	15.25	185	23	21	02	60.
1.01	41.05	42	0.01	0.00	0.01	1.01	15.30	186	23	21	02	60.
1.01	42.05	43	0.01	0.00	0.01	1.01	15.35	187	23	21	02	60.
1.01	43.05	44	0.01	0.00	0.01	1.01	15.40	188	23	21	02	60.
1.01	44.05	45	0.01	0.00	0.01	1.01	15.45	189	23	21	02	60.
1.01	45.05	46	0.01	0.00	0.01	1.01	15.50	190	23	21	02	60.
1.01	46.05	47	0.01	0.00	0.01	1.01	15.55	191	23	21	02	60.
1.01	47.05	48	0.01	0.00	0.01	1.01	16.00	192	23	21	02	60.
1.01	48.05	49	0.01	0.00	0.01	1.01	16.05	193	23	21	02	60.
1.01	49.05	50	0.01	0.00	0.01	1.01	16.10	194	23	21	02	60.
1.01	50.05	51	0.01	0.00	0.01	1.01	16.15	195	23	21	02	60.
1.01	51.05	52	0.01	0.00	0.01	1.01	16.20	196	23	21	02	60.
1.01	52.05	53	0.01	0.00	0.01	1.01	16.25	197	23	21	02	60.
1.01	53.05	54	0.01	0.00	0.01	1.01	16.30	198	23	21	02	60.
1.01	54.05	55	0.01	0.00	0.01	1.01	16.35	199	23	21	02	60.
1.01	55.05	56	0.01	0.00	0.01	1.01	16.40	200	23	21	02	60.
1.01	56.05	57	0.01	0.00	0.01	1.01	16.45	201	23	21	02	60.
1.01	57.05	58	0.01	0.00	0.01	1.01	16.50	202	23	21	02	60.
1.01	58.05	59	0.01	0.00	0.01	1.01	16.55	203	23	21	02	60.
1.01	59.05	60	0.01	0.00	0.01	1.01	17.00	204	23	21	02	60.

CFS 614. 142. 43. 43. 12403.
 CFS 17. 1. 1. 1. 351.
 INCHES 13.38 16.19 16.19 16.19
 AC-FT 339.79 411.20 411.20 411.20
 THOUS CU M 71. 85. 105. 105.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

PLAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 737. 171. 52. 14886.
 CFS 21. 1. 1. 422.
 INCHES 16.05 19.43 19.43 19.43
 AC-FT 407.75 493.43 493.43 493.43
 THOUS CU M 85. 103. 103. 103.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

PLAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 982. 228. 89. 19846.
 CFS 28. 8. 8. 256.
 INCHES 21.40 25.50 25.50 25.50
 AC-FT 543.67 657.91 657.91 657.91
 THOUS CU M 113. 137. 137. 137.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

PLAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 1228. 288. 89. 24703.
 CFS 33. 8. 8. 320.
 INCHES 26.76 32.58 32.58 32.58
 AC-FT 679.59 822.59 822.59 822.59
 THOUS CU M 141. 171. 171. 171.

HYDROGRAPH ROUTING

ROUTED FLOWS THRU LIPPS LAKE DAM

ISTAQ ICUMP IECUN ITAPE JPLT JPRI INAME ISTAGL IAU0
 000002 1 0 0 2 0 1 0
 QLOSS CLOSS AVG ROUTING DATA IOPT IPMP LSTR
 0.0 0.000 0.00 1 1 0 0
 NSTPS ANSTOL LAG AMSKK X TSM STORA ISPHAT
 1 0 0 0.000 0.000 0.000 -440.

STAGE 466.80
 FLOW 0.00

SURFACE AREA= 0. 2. 4. 5. 7. 11. 16. 21.
 CAPACITY= 0. 6. 34. 52. 89. 180. 312. 493.
 ELEVATION= 399. 410. 420. 430. 450. 460.

CHFL SPWFO COW EXPW ELEV COME CAREA EXPL
 466.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0

DAM DATA
 TOPPL COWD EXPD DAMVID
 466.8 2.8 1.5 850.

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
 BOTTOM OF RESERVOIR ASSUMED TO BE AT 399.00
 STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 460.00

--STATION=000002, PLAN 1, RTIO 1
 END-OF-PERIOD HYDROGRAPH ORDINATES

PLATE D-7

•UVA•

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA, (1) K
BOTTOM OF RESERVOIR ASSUMED TO BE A 399.00
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 460.00

1/2 PMF

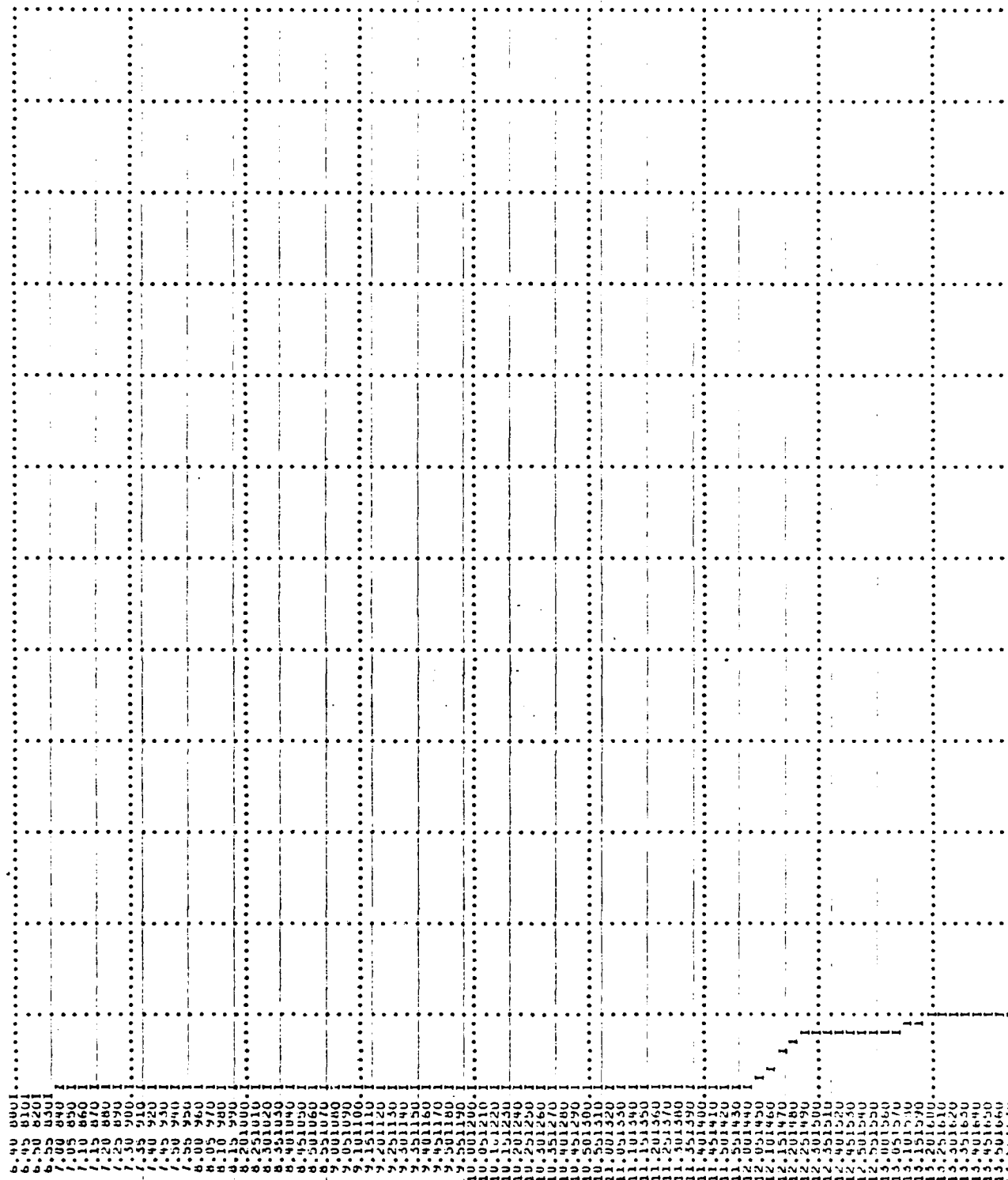
STATION U00002, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

[illegible]

STAGE	435.0	436.0	437.0	438.0	439.0	440.0	441.0	442.0	443.0	444.0	445.0	446.0	447.0	448.0	449.0	450.0	451.0	452.0	453.0	454.0	455.0	456.0	457.0	458.0	459.0	460.0	461.0	462.0	463.0	464.0	465.0	466.0	467.0	468.0	469.0	470.0	471.0	472.0	473.0	474.0	475.0	476.0	477.0	478.0	479.0	480.0	481.0	482.0	483.0	484.0	485.0	486.0	487.0	488.0	489.0	490.0	491.0	492.0	493.0	494.0	495.0	496.0	497.0	498.0	499.0	500.0
435.0	435.0	436.0	437.0	438.0	439.0	440.0	441.0	442.0	443.0	444.0	445.0	446.0	447.0	448.0	449.0	450.0	451.0	452.0	453.0	454.0	455.0	456.0	457.0	458.0	459.0	460.0	461.0	462.0	463.0	464.0	465.0	466.0	467.0	468.0	469.0	470.0	471.0	472.0	473.0	474.0	475.0	476.0	477.0	478.0	479.0	480.0	481.0	482.0	483.0	484.0	485.0	486.0	487.0	488.0	489.0	490.0	491.0	492.0	493.0	494.0	495.0	496.0	497.0	498.0	499.0	500.0



6.00 8001
6.05 8101
6.10 8201
6.15 8301
6.20 8401
6.25 8501
6.30 8601
6.35 8701
6.40 8801
6.45 8901
6.50 9001
6.55 9101
6.60 9201
6.65 9301
6.70 9401
6.75 9501
6.80 9601
6.85 9701
6.90 9801
6.95 9901
7.00 1000
7.05 1010
7.10 1020
7.15 1030
7.20 1040
7.25 1050
7.30 1060
7.35 1070
7.40 1080
7.45 1090
7.50 1100
7.55 1110
7.60 1120
7.65 1130
7.70 1140
7.75 1150
7.80 1160
7.85 1170
7.90 1180
7.95 1190
8.00 1200
8.05 1210
8.10 1220
8.15 1230
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8.65 1330
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8.85 1370
8.90 1380
8.95 1390
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9.10 1420
9.15 1430
9.20 1440
9.25 1450
9.30 1460
9.35 1470
9.40 1480
9.45 1490
9.50 1500
9.55 1510
9.60 1520
9.65 1530
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9.75 1550
9.80 1560
9.85 1570
9.90 1580
9.95 1590
10.00 1600
10.05 1610
10.10 1620
10.15 1630
10.20 1640
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10.40 1680
10.45 1690
10.50 1700
10.55 1710
10.60 1720
10.65 1730
10.70 1740
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PMF

STATION 000002, PLAN 1, RATIO 7
END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

[illegible][illegible]

CONFIDENTIAL

SIAT10N000002

[illegible]

PLATE D-16

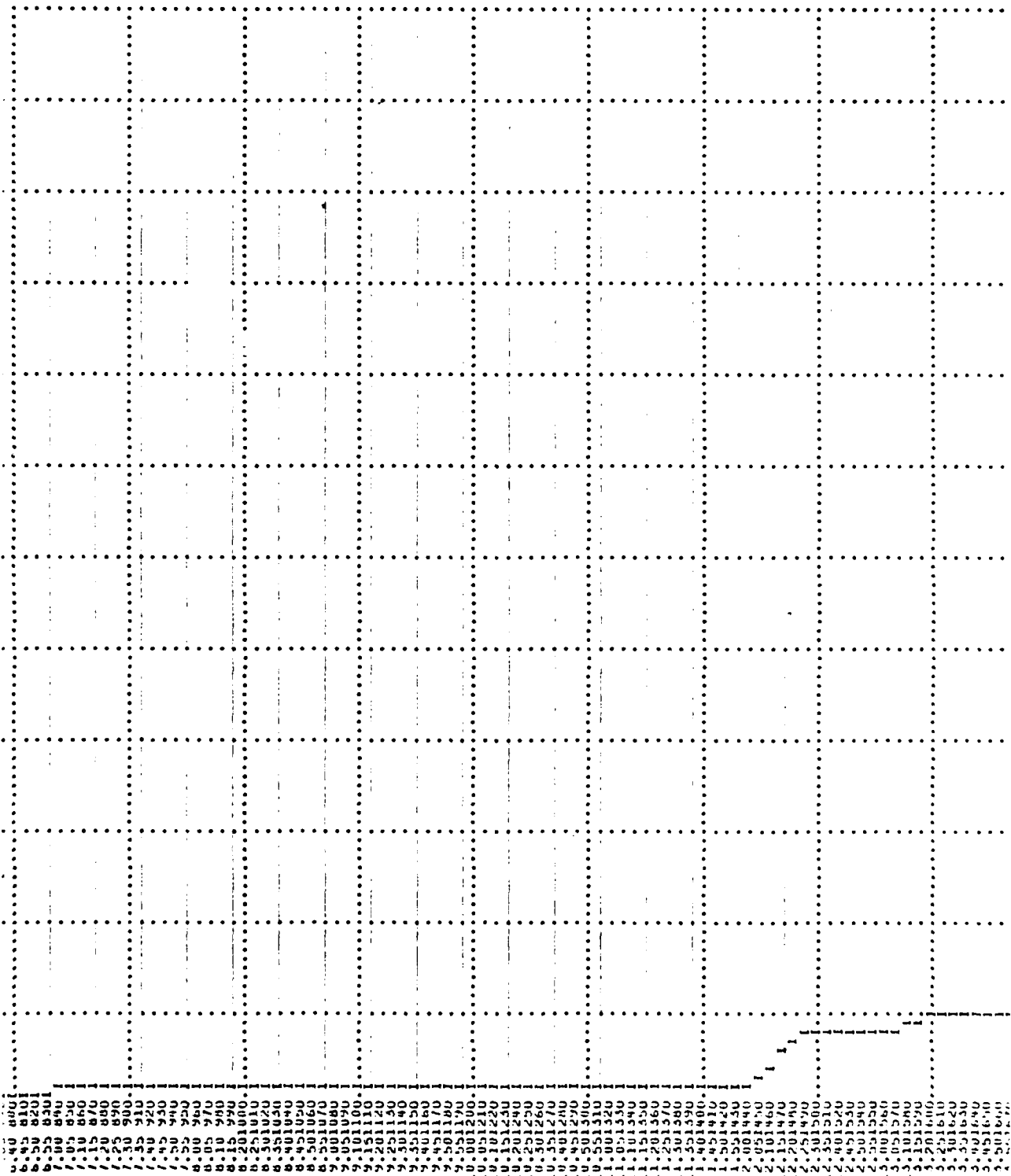


PLATE D-17

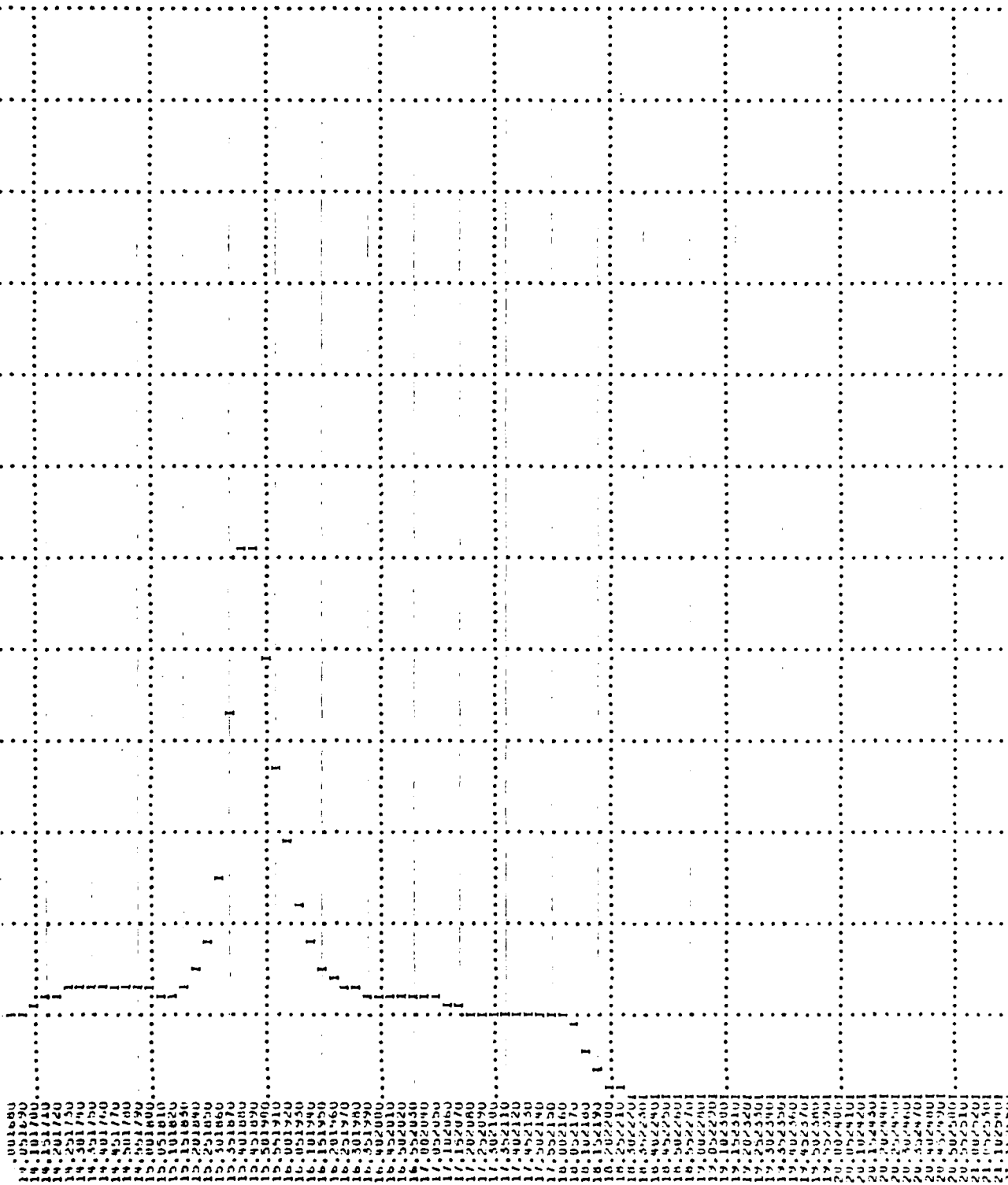


PLATE D-18

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PLAN FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC FEET PER SECOND)
 AREA IN SQUARE FEET (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS									
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO 10
HYDROGRAPH AT	UUUUU1	.10 (.26)	1	123 (5.40)	246 (6.95)	491 (13.91)	614 (17.38)	737 (20.86)	982 (27.82)	1228 (34.77)			
	UUUUU2	.10 (.26)	1	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)			

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 439.80 177. 0.	SPILLWAY CREST 466.80 650. 0.	TOP OF DAM 466.80 650. 0.			
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	441.42	0.00	192.	0.	0.00	0.00	0.00
.20	442.76	0.00	212.	0.	0.00	0.00	0.00
.30	443.44	0.00	246.	0.	0.00	0.00	0.00
.40	444.64	0.00	263.	0.	0.00	0.00	0.00
.50	445.90	0.00	280.	0.	0.00	0.00	0.00
.60	447.17	0.00	314.	0.	0.00	0.00	0.00
.80	450.17	0.00	348.	0.	0.00	0.00	0.00
1.00	453.29	0.00	0.	0.	0.00	0.00	0.00

APPENDIX E
PRELIMINARY SLOPE STABILITY ANALYSES

PRELIMINARY SLOPE STABILITY ANALYSES

The Simplified Bishop Method was used. Computations were based on the following assumptions:

- Phreatic line developed from elevation 452 (PMF) to downstream slope elevation of 415.
- Embankment dry unit weight - 100 pcf.
- $\bar{\phi} = 30^{\circ}$
- $\bar{c} = 300$ psf
- Embankment height = 75 feet at elevation 473.
- Foundation 10 feet deep having same properties as the embankment and underlain by bedrock.

The results of the preliminary analysis are as shown in the table below:

<u>Section</u>	<u>Factor of Safety</u>		<u>Factor of Safety</u>	
	<u>Computed</u>	<u>Required</u>	<u>Computed</u>	<u>Required</u>
Overall	1.92	1.5	1.01	1.0
Below Berm	1.72	1.5	1.06	1.0

Plate E-2 summarizes the results of the analyses.

minimum
 $FS = 1.02$
 $FS = 1.01$ with $AE = 0.159$

minimum
 $FS = 1.72$
 $FS = 1.06$ with $AE = 0.159$

$FS = 1.02$
 $FS = 1.01$ with $AE = 0.159$

$FS = 1.02$
 $FS = 1.01$ with $AE = 0.159$

$FS = 1.02$
 $FS = 1.01$ with $AE = 0.159$

PLATE F-2

